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The ILLUMINATING ENGINEER

ELECTRICITY · ACETYLENE · OIL · GAS

Edited by LEON GASTER

10/6 Yearly. THE JOURNAL OF SCIENTIFIC ILLUMINATION. *1/- a Copy.*

OFFICIAL ORGAN OF THE
Illuminating Engineering Society.
(Founded in London 1909.)

Among other articles this number contains:—

A Logarithmic Illumination Chart.

Lighting in the Army.

Recent Developments in Searchlights in the United States.

A Paper entitled:

The Human Element in Factories, read by ***Mr. B. S. Rowntree,*** Director of the Welfare Department, Ministry of Munitions of War, at a meeting of the Circle of Scientific, Technical, and Trade Journalists, on Tuesday, November 14th.

TOPICAL AND INDUSTRIAL SECTION—REVIEWS OF BOOKS—CORRESPONDENCE, &c.

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EDITORIAL.

Welfare Work in Factories.

In this issue we are reproducing (pp. 341-352) the inspiring Paper on "The Human Element in Factories" read by Mr. B. S. Rowntree, Director of the Welfare Department of the Ministry of Munitions of War, at the last meeting of the Circle of Scientific, Technical, and Trade Journalists, together with the ensuing discussion.

Apart from its general interest and extreme importance at the present moment, this discussion should be of special interest to many of our readers, in view of its close relation with much of the work done in connection with illuminating engineering. Mr. Rowntree points out that it is impossible for men to do their best work if the conditions in factories are unsuitable, if the hours of work are excessive, if workers do not receive sufficient nourishing food, and if the rooms in which they work are insufficiently heated, poorly lighted, or badly ventilated. Welfare work, which ensures that the

needs of the workers receive proper consideration, is therefore thoroughly justified from the economic as well as the humanitarian standpoint.

Now this is exactly the line of argument pursued from the very commencement of the illuminating engineering movement in this country. The essential idea underlying our propaganda has been that illumination should be considered on its merits as a necessity in modern life, and that the relatively small expenditure involved in lighting a room properly was amply repaid by the greater comfort and convenience secured. The public service to be done in this direction was aptly expressed in the closing sentences of the late Professor Thompson, in his Inaugural Address to the Society in November, 1909, when he said :—

> "I trust, therefore, that before long our Society will become generally recognised as one of public utility, having a real purpose to fulfil. . . . Meanwhile, we have an immediate and direct function to discharge in the collection, discussion, and dissemination of knowledge ; and in arousing the interest of the public and of public bodies to the economic and social importance of the questions for which we are now united to form a Society."

In the case of industrial lighting the influence of illumination is specially evident. It has been shown that insufficient or badly arranged lighting is a cause of spoiled work, leads to fatigue, and tends to increase accidents. This view was endorsed in the Report of the Departmental Committee on Accidents in Factories, and confirmed in the subsequent investigations forming the Report of the Departmental Committee on Lighting in Factories and Workshops which reported last year. The conclusions of this Report were again endorsed in the bulletins issued by the Committee on the Health of Munition Workers.

The recognition of these facts has come about mainly by slow and painstaking work, involving the utilisation of the best channels for moulding public opinion, by concerted action, wherever possible, with associations and societies interested in any particular aspect of lighting, and by securing the sympathetic co-operation of the scientific and technical Press.

The aims of illuminating engineering are closely related to those of welfare work, of which the lighting of factories forms an essential section. We are therefore justified in assuming that much of the experience gained in connection with illuminating engineering will apply to the broader aspects of welfare work, and that similar methods will have to be pursued in order to gain the interest and support of the general public.

Mr. Rowntree's highly appreciated paper before the Circle furnished one illustration of the kind of propaganda work that is needed. It is essential, in the first place, to interest employers throughout the country in the movement. And when this stage has been reached we are still at the beginning of what needs to be done. Welfare work is itself in a state of flux. Those engaged in it are constantly discovering new possibilities and new outlets for their energy. Each experiment should be recorded, and the results of each innovation noted for future use. We hope, therefore, that those associated with the movement will see to it that information regarding each development is made widely known to the Press, in order that they can be kept informed of all its ramifications, and bring them in suitable form before employers interested in their application.

The good seed thus sown will bear good fruit in time to come, and it is our hope that in this respect good will come even out of the present terrible conflict, and that a more cordial relation will gradually be established between employer and employee.

Scientific and Industrial Research in Australia.

Readers will recall that at a meeting of the Circle of Scientific, Technical, and Trade Journalists, on May 16th, an address was given by Mr. Gerald Lightfoot on the Scheme for a Federal Institute of Science and Industry in Australia.

Through the courtesy of Mr. Lightfoot we have since received a series of Reports, issued by the Executive Committee in charge of this scheme, which show that the Commonwealth Government is already taking active steps towards the practical realisation of the aims of such an Institute.

Each State has been requested to form a local Committee to deal with the matter. Circulars have also been drawn up and issued to all the local authorities throughout Australia, asking for particulars of any researches which it is thought would be helpful to local industries, and for information on the resources of existing institutions. Another step in contemplation is the preparation of a Census of Production of the chief industries of Australia.

While, for the moment, expenditure appears to be on a modest scale, the necessary machinery for obtaining such information is now in operation. It will be recalled that one important element in the proposed scheme was the creation of a central Bureau of Information on Scientific subjects. We observe that a small beginning has now been made, a section of the Melbourne Public Library being allotted for this purpose.

An interesting feature of the Report is the reproduction of statements from various localities on researches desired, or already undertaken. Most of these relate to agricultural, pastoral, or mining problems. Naturally the Australian Government may be expected to give precedence to problems connected with their local industries, but the results of their experiments would often have a wider interest, and the assistance of scientists in this country would doubtless be helpful in many cases.

It is our earnest hope that as these movements for the encouragement of research develop throughout the Empire, measures will be taken to secure their co-ordination with each other, and with the Mother Country. We are glad to see that this aspect of the matter has been brought to the notice of the Committee of the Privy Council for Industrial and Scientific Research, which has expressed its general approval of this view and suggested some principles that ought to govern such co-operation.

Meantime, in order that we in this country may be in a position to afford the fullest assistance to the efforts of the Colonies and Dominions, it is essential that the aims of the Authorities should be clear and definite, and that there should be available ample funds to enable researches to be conducted on a large scale.

An important statement on this point has just been made by Lord Crewe to a Deputation from the Conjoint Board of Scientific Societies. It was stated that a large sum is to be allotted to scientific and industrial research which will enable an expenditure four or five times the present vote for the purpose to be made over a period of five years; that additional funds are to be devoted to improving the position of the staff of educational institutions, and that expenditure by firms out of profits on industrial research will receive special encouragement. We shall refer to this matter more fully in our next number.

Street Accidents.

Some interesting figures were officially given recently in reply to a question by Mr. Gilbert, M.P. From these data it appears that there has been a progressive increase in the number of accidents caused by motor vehicles. This is made still more evident when we add the corresponding figures for 1913, which were not included in those given in the House. The totals are as follows :—

Year.	Total number of Fatal Accidents in the London Metropolitan Police District, caused by motor vehicles of all kinds.	Total Number of Non-fatal Accidents in the London Metropolitan Police District, caused by motor vehicles of all kinds.
1913*	424	13,153
1914..	493	14,638
1915..	666	16,366
1916 to Oct. 31st..	509	11,827

*Taken from the Returns on Street Accidents caused by vehicles during 1913, presented to the House of Commons, February 26th, 1914.

The increase during the years 1913, 1914, and 1915 is marked. The figure for 1916 is apparently low, but the two dark months, November and December, are not included, and therefore the data are not comparable.

While these figures are conclusive as regards the increase in accidents since the outbreak of war, they do not furnish all the information we need in order to establish their relation to the lighting conditions. It must be remembered that the number of motor vehicles traversing the streets, and also the number of people using them at night, are doubtless considerably less than in pre-war days. Furthermore, the speed of motor vehicles is probably less, greater care is exercised both by drivers and pedestrians, and statistics indicate a marked tendency towards sobriety (which is naturally conducive to the safety of pedestrians) since the outbreak of war. The authorities have also taken special measures for the safety of the public, such as the recent recommendation that the rule " keep to the right " should be adhered to more closely.

In spite of all these facts the number of street accidents tends to increase. The alteration in illumination—not only as regards diminution but, also the extreme contrasts that prevail in some streets—is doubtless one important factor in the causation of accidents. With a view to developing greater uniformity of method, it would be a great advantage if, during the war, the lighting of London could be placed under a single authority, acting under the best expert advice.

With a view to establishing conclusively the relation between accidents and illumination, it would be useful if the following additional data could be furnished, or, if not at present available, collected in the future :—

(1) The returns of the accidents during *each month* of the period referred to above.
(2) The respective numbers of accidents in each month during the day, and between sunset and sunrise.
(3) The dates at which further restrictions in lighting have been introduced.
(4) The approximate figures for the number of licensed motor vehicles, tramcars, etc., plying in London in each month.
(5) The dates at which restrictions, if any, in the speed of such vehicles, have been introduced.

Information on these lines would be of great assistance to lighting authorities in the future in determining the best method of illuminating the streets, and the regulation of the speed of traffic.

LEON GASTER.

A LOGARITHIMIC ILLUMINATION CHART.*

The representation of distribution of horizontal illumination between two lamps spaced a considerable distance apart is attended with some difficulty. In general the illumination falls away very rapidly as we recede from the base of the lamp, until, midway between the lamps, it may be but a small fraction of that immediately underneath them. If, therefore, we select a scale sufficient to show the higher values, differences in the mid-point illumination become almost unrecognisable, and to the uninitiated there appears little difference in the performances of two types of unit, although one may give twice or three times the minimum illumination of the other.

The question is of greater importance nowadays in view of the tendency to lay stress on the minimum illumination provided in a street, as suggested in the Draft Standard Specification of the Joint Committee on Street Lighting, presented by Mr. Trotter before the Illuminating Engineering Society in 1913. Moreover, during recent years much more attention has been given to the design of units giving more uniform lighting conditions. After the war, when street lighting in this country will doubtless be more scientifically studied, the possibilities of such units will be closely studied.

It is, therefore, of interest to notice a method of exhibiting distribution of illumination devised under the supervision of Mr. W. D'A. Ryan in the laboratory of the General Electric Co. (U.S.A.). It is pointed out in a Report on this method that several years ago it was seldom necessary to calculate illumination at points further from the lamp than ten times its height. A lamp suspended 15 feet above the street did not, as a rule, give satisfactory minimum horizontal illumination beyond 150 feet (*i.e.*, 0·006 ft.-candles at a distance equal to ten times the height of the lamp. But units are now being designed, particularly those of the prismatic glass type, which, when suspended at the above height, will produce this illumination at a distance of 180—240 feet. For example, in one such unit, having a polar curve specially designed for street lighting, the intensity at 80°—84° is increased from 1,300 to 2,100 candles, while the downward component is decreased from 500 to 100 candles. The distribution of illumination is thus more uniform and the lamp is effective for a proportionally greater distance.

In such cases the conventional method of depicting distribution of illumination has, as stated above, distinct drawbacks. Sometimes the scale of the curve may be changed as the distance increases, with a view to showing more clearly what happens in the more remote parts, but the breaks in the continuity of the curve are a bad feature destroying its fundamental simplicity, and leading to possible misunderstanding and confusion. In order that such curves may be used by a salesman when approaching customers, the curve should be an actual picture of results.

Now the "ultimate consumer" in judging street lighting, is not guided by considerations of "candle-power" or "foot-candles," but by the physiological impression derived from the illumination produced. The sensation varies as the logarithm of the illumination, and this in itself furnishes an argument for presenting results with a logarithmic scale.

The chief advantages of such a scale are:—

(1) An unbroken curve over great ranges of illumination.

(2) A single scale for the entire curve.

(3) It makes practicable the use of a fixed standardised web for all street units.

(4) There is uniform accuracy throughout.

(5) The sensation values are pictured in a manner that gives a reasonably accurate impression.

The great majority of illumination curves, possibly ninety-nine per cent., have for their equations some simple form such as

$$E_h = \frac{I\alpha}{H^2} \cdot \cos^3\alpha \quad \ldots \quad \ldots \quad (1)$$

for horizontal illumination,

$$E_n = \frac{I\alpha}{H^2} \cdot \cos^2\alpha \quad \ldots \quad \ldots \quad (2)$$

*Based on a Report presented by W. D'A. Ryan of the Laboratory of the General Electric Co. (U.S.A.), in 1915.

for normal illumination,

$$E_s = \frac{K.I\alpha}{H^2} . \cos^3\alpha \quad .. \quad (3)$$

for the illumination along a vertical surface such as a wall.

The above equations can be easily applied in a logarithmic form, thus :—

$$\log E_h = \log I\alpha + \log \cos^3\alpha - \log H^2 \; .. \quad (4)$$

$$\log E_n = \log I\alpha + \log \cos^2\alpha - \log H^2 \; .. \quad (5)$$

$$\log E_s = \log K + \log I\alpha + \log \cos^3\alpha - \log H^2 \quad (6)$$

The suggested chart is simply a device for adding and subtracting logarithms, as indicated in the above equations. The operations do not involve logarithmic calculations and are carried out on the same principles as on a slide rule.

The full page illustration is a reproduction of a typical logarithmic chart. In the top right-hand corner is a candle-power web. This, however, plays no direct part in the operation of the chart. Candle-power values are usually plotted at intervals of ten degrees and may be recorded on the space down the right-hand side of the chart.

At the bottom of the chart are two spaces occupied by curves that are similar in shape but have different spacings. The lower set of curves are used for obtaining normal ilumination, the upper for horizontal illumination. At the extremities of these spaces are scales for various heights of lamps varying from ten to twenty-five feet. The curves give the expressions appearing in equations (4)– (6).

A straight line drawn from any height, say 21 feet, on the left-hand height scale to the same height on the right-hand height scale will intersect the horizontal curves at distances proportional to :—

$\log \cos^3 0 - \log 21^2$

$\log \cos^3 10 - \log 21^2$

$\log . \cos^3 88^\circ 33' - \log 21^2$

Similarly for the " normal " curves.

The sloping lines in the middle of the chart are spaced according to the logarithms of the intensity of the light in candles. The length of a vertical line drawn from the candle line is proportional to log I. To the left is a scale of foot-candles. Across the top of these intensity lines is a radial distance scale that extends to 500 ft.

The set of straight lines above the distance scale are " tangent " lines. A straight line drawn through 21 on the scales at right and left intersects the tangent lines at distances that are proportional to the distances (from the base of the lamp) at which the rays from the lamp strike the street.

At the top of the chart is a set of arcs of circles that may be used to find the illumination along a line that does not pass beneath the lamp. These arcs of circles replace the arcs of ellipses used on the old form of illumination chart. Illumination along any line within one hundred and fifty feet may be obtained by use of these arcs.

In the illustration actual candle-power values are shown plotted in the right-hand corner, and down the right-hand edge. Suppose now that the horizontal illumination for heights of 20, 25 and 30 feet are desired. Starting with the 20 feet height the straight line, LL, is drawn through the 20-feet marks on the scalesat the ends of the set of " horizontal " curves, and also a similar line, L′L′, at the same height on the set of tangent lines. A set square is placed with the vertical side through the intersection of the line, LL, just drawn and the zero degree horizontal curve. The intensity 1562 is then plotted at B on the candle scale vertically over the intersection point I.

The height, AB, of the point located is equal to the logarithm of the illumination as measured on the scale on the left. The point at which this intersection occurs is directly beneath the lamp and the point C on the illumination curve is obtained.

In a similar manner another point, G, on the illumination curve, is determined for 70 degrees, using the line L′L′, G being the intersection of lines FG and HG. The extension of the process, using lines KK, K′K′, MM, M′M′, etc., gives results for heights of 25 and 30 feet respectively. In dealing with normal illumination we may first obtain a horizontal illumination curve and then move it bodily up and down a distance corresponding with log K. Thus if the value of K were 0·4 the curve is moved up until the point

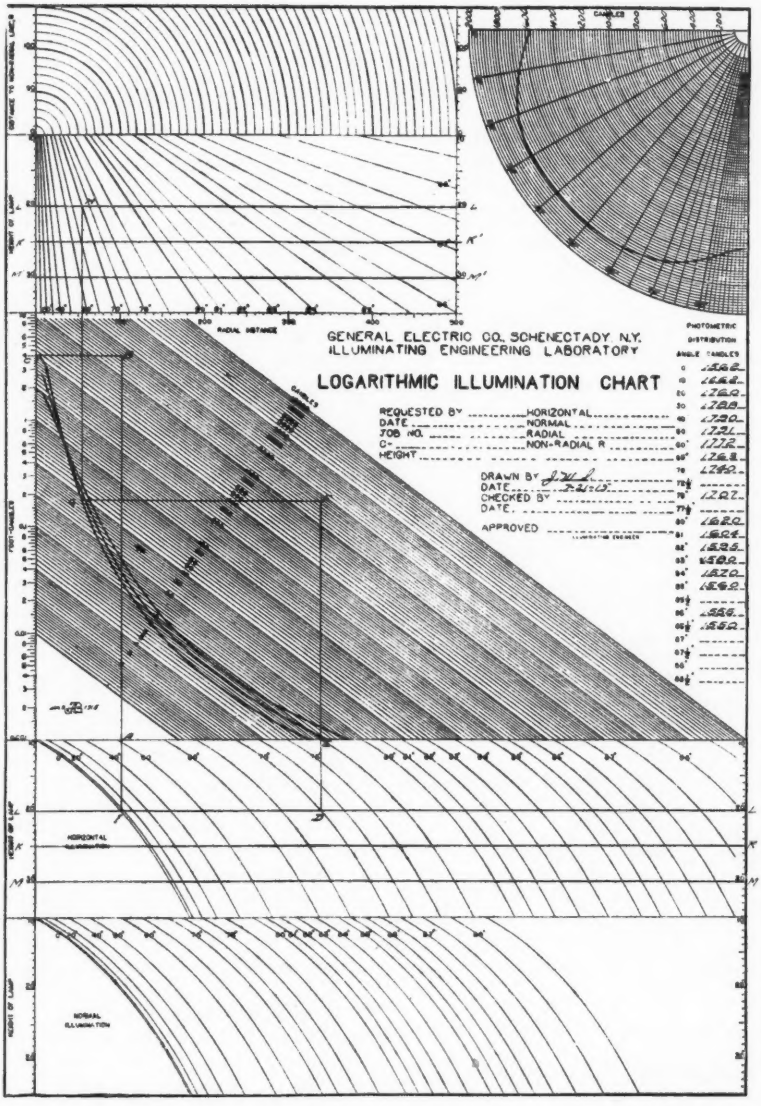

FIG. 1.—Complete Chart for Determination of Illumination Curves on a Logarithmic Scale. (Mr. W. D'A. Ryan.)

0·4 foot-candles coincides with 1 foot-candle on the chart.

On a standard blue print the curve plotted to a logarithmic scale may have a range of 10—0·001 foot-candles, which suffices for all ordinary purposes. The accuracy of the graphical arrangement compares very favourably with that obtainable on the old form of illumination chart, and is uniform throughout the scale.

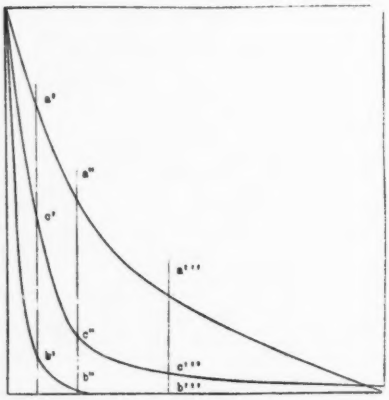

FIG. 2.—Showing a′ a″ a‴ Illumination Curve plotted to logarithmic scale.

b′ b″ b‴ Illumination Curve plotted to linear scale.

c′ c″ c‴ Sensation Curve plotted to linear curve (coeff. of reflection 0·30).

In fig. 2 are plotted side by side illumination curves to a linear and logarithmic scale and the sensation curve assuming a coefficient of reflection of 0·3. The great advantage for distant points is demonstrated. The difference in shape of curves a′ a″ a‴ and c′ c″ c‴ is doubtless due to the Purkinje effect which begins to operate below 0·1 foot-candle.

ACCIDENTS IN THE STREETS.

In reply to a question by Mr. Gilbert, Mr. Herbert Samuel has given the following statistics relating to the number of people killed in the Metropolitan Police District through street accidents in the course of 1914, 1915, and up to October 31st in the present year :—

Year.	Tramway Cars.	Motor Omnibuses.	Other Mother Vehicles.
	No. of persons killed by—		
1914	37	148	308
1915	86	154	426
1916 to Oct. 31	63	135	311
	No. of persons injured—		
1914	3,171	3,007	8,460
1915	4,001	2,572	9,793
1916 to Oct. 31	3,085	1,810	6,937

In the same periods, the number of accidents caused by tramcars was 5,254, 6,142, and 4,594 respectively; by motor omnibuses 6,521, 4,981, and 3,394; and by other motor vehicles 20,150, 21,913, and 15,988.

It will be observed that the period up to October 31st, omitting the two dark months of November and December, hardly gives a full indication of conditions in the present year, and it must also be remembered that the number of persons using the streets at night, and also the number of vehicles, is probably much less than before the war.

PARIS TO BE LIGHTED BY CANDLES.

Paris, "La Ville Lumière," is now experiencing yet a further diminution in illumination. According to a recent decree of the Prefect of Police the shops and stores are not to be lighted after six o'clock in the evening by gas, electricity, petroleum or spirit. An exception is made in favour of shops dealing in foodstuffs, druggists, hairdressers and tobacconists. Shops are not compelled to shut at 6.p.m., but if they remain open after this time they must find other means of lighting.

Another reform is the closing of cafés and restaurants from 9.30 onwards.

THE UNLIGHTED STAIRS.

Sir Thomas Tacon is confined to his bed suffering from sprains to both knees caused by falling down a staircase while on his way to attend a meeting of the Eye Tribunal There was no light near the stairs.

LIGHTING IN THE ARMY.

The Illuminating Engineering Society in the United States is evidently applying its attention closely to lighting problems in connection with naval and military matters. We recently gave an account of some points raised in a recent paper by Lieut. McDowell on "Illumination in the Navy." The October issue of the *Transactions* of the Society contains a similar address by Capt. Ed. D. Ardery on lighting in connection with army work.

There is no doubt that in many of these fields experts on lighting could make useful suggestions. Most of the remarks made in this paper would no doubt meet with general agreement. While gas and oil, as well as electricity, are used for lighting officers' quarters and barracks, open flames are naturally considered inadvisable in the neighbourhood of magazines. Acetylene is well adapted for tents utilised for clerical work, but it is recommended that the flame should be kept within a chimney with a view to avoiding flickering. For trench-digging, road-repairing, &c., acetylene portable outtfis may be useful, and a light fed from a small acetylene generator, slung on the back of the leading man, is useful for indicating the line of march of columns moving in the dark. (While these remarks may apply to home service the necessity for concealing movements from the enemy may, however, modify considerably such methods in actual warfare. The problem of providing sufficient light for work, without attracting attention, is not an easy one, and proper shading devices would seem essential. Capt. Ardery mentions that in view of these considerations army lanterns so used are specially constructed to throw light downwards.) Another device mentioned is the attachment of light-coloured objects to the backs of the belts of the men, so that, on a dark night march, they will find it easier to keep their distance.

A rather curious appliance used for hunting in the Philippines is the attachment of small acetylene lamps to the head, with the light immediately over one eye. The eyes of a deer brightly reflect this light and appear as fiery discs, making it easy to sight between them.

Among other matters dealt with the author emphasises the need for alternative systems of supply at points of importance. Thus at the sea coast forts in the United States there is in many cases an electric generating plant on the premises as well as facilities for using the town supply. It is also common practice to install 25 k.w. gasoline plants near the batteries.

It is stated that the local abnormal air pressures set up by the firing of big guns often extinguish gas lights or oil lanterns, and electric lights are therefore preferable.

The illumination of gun platforms presents many special problems, as it is by no means easy to secure the proper conditions of illumination and, at the same time, to avoid the eyes of the men being dazzled by exposed lights.

The remainder of the article deals with the use of searchlights, a matter which was also covered in the paper by Lieut. McDowell.

DEVELOPMENTS IN SEARCHLIGHTS IN THE UNITED STATES.

In the recent paper by Lieut. McDowell before the Illuminating Engineering Society (U.S.A.) on "Illumination in the Navy"* mention was made of the new searchlight with cooled electrodes being developed in the United States. Some further particulars are now given in the *Electrical World*.

One of the new searchlights is mounted on the Sperry Building, Brooklyn, N.Y. It is stated that the beam is visible 50 miles away, and that attempts will shortly be made to signal over a distance of 91 miles. The source of light is stated to be not the incandescent crater, but a superheated vapour within it, obtained by using impregnated carbons. An intrinsic brilliancy exceeding 500 c.p. per sq. mm., or more than 320,000 c.p. per sq. inch, is obtained; this is 65 per cent. of the brightness of the sun at 30° elevation and nearly 3½ times the brilliancy of the pure carbon arc crater. At the same time the area of the crater has been diminished, giving a more concentrated beam.

The following particulars of the lamps are also mentioned :—

Current.	Type of Lamp.	Diameter.		Consumption of Positive Electrode.	Illumination produced at a distance of ½ mile.	Equivalent Candle-power.† (approx.)
		Positive Electrode.	Negative Electrode.			
					ft.-candles.	
150 amps.	36"	⅝ in. slightly larger	7/16 in. slightly larger	13·5 in. per hr.	30	210,000,000
200 ,,	60"			—	85	550,000,000

It is stated that in the case of the 200-amp. arc the dispersion does not exceed one degree. Unlike the Beck lamp, this new lamp is not cooled by means of alcohol but by the agency of a blast of air which is forced up through the hollow electrode supports and impinges on the electrode. In view of the small size of the source, it is important (1) that the source should be maintained in a symmetrical condition, (2) that its position with respect to the focus of the minor should be unaltered. The first requirement is met by a small motor which keeps the electrode in continuous rotation, the second by using a differential thermostatic device which automatically keeps the arc within 1½ millimetres of the focal point.

OUTDOOR PAGEANT LIGHTING ON A LARGE SCALE.

A recent number of the *Lighting Journal* (U.S.A.) describes the novel artificial lighting conditions required for the outdoor performance of the mammoth pageant "Caliban" performed at the Stadium of the College of New York. The Stadium is circular and has a seating capacity of 20,000. The stage-area is 80 ft. long, 20 ft. deep, and 40 ft. high, and was illuminated by a series of gas-filled lamps in projector-reflectors, situated a distance of 300 feet. These lamps required in all about 1400 amperes.

The colour and intensity of light could be readily adapted to the requirements of the performance, and it is said that the lamps were so well situated that the source of light was not at all noticeable. The fact of gas-filled lamps being used was helpful in enabling all lighting effects to be controlled from a single switchboard at the back of the stage.

During the arrival of the audience they were prevented from seeing what was happening on the stage by the use of several 1000-watt lamps in glass-lined reflectors, which were turned towards them, producing a "mild blinding in the direction of the stage, thus acting as a complete screen or curtain of light."

One may doubt if this form of screen will be found generally acceptable to audiences, even if contrived on the most efficient and up-to-date lines.

* *Illum. Eng.*, Sept., 1916.

† Calculated from preceding column.

CIRCLE OF SCIENTIFIC, TECHNICAL, AND TRADE JOURNALISTS.

THE HUMAN ELEMENT IN FACTORIES.

(Discussion at a meeting of the Circle of Scientific, Technical, and Trade Journalists, held at 5 p.m., on Tuesday, November 14th, in the Hall of the Institute of Journalists, Tudor Street, E.C.)

THE Annual Meeting of the Circle took place at the Institute of Journalists at 4.30 p.m. on Tuesday, November 14th, when a report on the proceedings during the past session was presented by the Chairman, and accepted. In view of the attention now being paid by the Circle to the question of Technical Education and Industrial Research, and the importance of preserving continuity in this work, it was resolved that the Officers and Committee for the past session should be re-elected.

At 5 p.m. a General Meeting of the Circle was held in the Hall of the Institute, Mr. L. Gaster being in the Chair.

In introducing Mr. ROWNTREE, the speaker for the evening, the CHAIRMAN referred to the great industrial changes that had taken place since the outbreak of war, especially in connection with munition work, which had rendered the study of conditions of work in factories of vital importance. The work done in this direction by the Welfare Department of the Ministry of Munitions was of great national value, not only in promoting better and more hygienic conditions of work, but in bringing about more cordial relations between employer and employee. The Circle was very fortunate in hearing Mr. B. S. ROWNTREE, the Director of this Department, whose experience on the matter was unique. The nature of this work deserved to be more widely known, and the scientific and technical Press could render valuable aid in this direction.

Mr. B. S. ROWNTREE (Director of the Welfare Dept., Ministry of Munitions) then read his paper on "The Human Element in Factories" (see pp.343—347). Welfare work, he pointed out, might be defined as "the humanising of industrial conditions." In the old days when industry was conducted in small factories, the employer knew his workers personally and took an interest in them. In the huge factories of to-day this is no longer possible. Hence welfare departments are being organised in many factories, and many hundreds of welfare supervisors have been appointed since the outbreak of war. Mr. Rowntree described in detail the work undertaken by such supervisors, and mentioned cases in which their efforts had quite revolutionised conditions of work, bringing about better relations between the employer and the staff, and materially improving output and quality of work. "No method of conducting industry," he added, "is satisfactory which leads to a waste of human effort, and unless workers are happy and contented and well they cannot put forth their best efforts."

At the conclusion of Mr. Rowntree's address the CHAIRMAN read extracts from a number of letters expressing regret at inability to attend and interest in Mr. Rowntree's work. These included communications from Viscount HALDANE, the Rt. Hon. ARTHUR HENDERSON, and Mr. A. G. GARDINER (President of the Institute), while Sir WILLIAM LEVER, Sir RICHARD BURBIDGE, and Mr. GORDON SELFRIDGE, as large employers of labour, expressed the view that good work could only be accomplished when cordial relations were established between management and staff.

A vote of thanks to Mr. Rowntree was proposed by Mr. A. J. MUNDELLA (Chairman of the London District), and seconded by Mr. GILBERT WOOD, and a discussion ensued in which Mr. A. T. DALE, Mr. G. BELLHOUSE, Mr. E. H. PELHAM, Mr. A. P. M. FLEMING, Dr. E. L. COLLIS, Miss L. E. PATTERSON, Miss A. A. SMITH, Miss B. O'REILLY, and Mr. S. R. LITTLEWOOD took part.

Mr. ROWNTREE, in replying to the discussion, expressed his pleasure in addressing the Circle, and the hope that the scientific and technical Press would co-operate in making the importance of the subject more fully recognised by manufacturers.

CHAIRMAN'S INTRODUCTORY REMARKS.

The CHAIRMAN (Mr. L. Gaster): The subject on which Mr. Rowntree is about to address us is one not only of great present moment, but of vital importance to our industrial future.

The great crisis through which we are now passing has served to emphasise the importance of careful study of conditions of work in factories. Large masses of men, women and children have been removed from their normal conditions to do unfamiliar work in novel circumstances and at exceptional pressure. Those at work in the munition factories are giving their utmost in health and strength.

The welfare movement, therefore, satisfies an admitted need. I do not wish to anticipate what Mr. Rowntree is going to tell us of the admirable work of the Welfare Department of the Ministry of Munitions. Some of you, however, are familiar with the series of bulletins on such subjects as hours of work, housing, canteens, heating, lighting and ventilation, etc., which the Committee on the Health of Munition Workers has been issuing during the past and present year. These bulletins have shown by actual facts and figures how impossible it is for workers to do their best if they are overworked, underfed, and badly housed. They have demonstrated in a most convincing manner that even from a purely economical standpoint it pays to care for the welfare of the worker, and to see that he is comfortable and contented.

I do not, however, wish to refer to the movement on this ground alone. The country is rightly bending all its energies on the immediate task before it. And yet we must think of the future as well. If bad conditions of work prevail, especially among the women and children now engaged in industry, they will not only prove uneconomical now, but will prejudice the physique of the nation and of future generations in the future.

Neither do we regard the welfare movement as beneficial only because it increases the worker's capacity and is therefore profitable. From a wider standpoint this movement ought to appeal to us as a ground of common contact between capital and labour, as work in which both must participate if genuine success is to be obtained, and as an indication of the spirit of co-operation which will lead the worker to feel that his or her work is a service to the country, and a source of legitimate pride.

The many lessons we are learning from this terrible war will surely not be forgotten when the conflict is at an end. That there are great industrial changes to come after the war we most of us believe. That they will be accompanied by fuller co-operation and the coming of a more cordial and friendly spirit between employer and employee we all of us hope. Not the least useful approach to these better conditions is by the aid of the welfare work, on which Mr. Rowntree is going to address us to-night.

We, as journalists, can do a share of the good work. It is only by much patient educational effort that the country can be brought to recognise the vital importance of this subject. And even when manufacturers are united in desiring guidance there is still the problem of finding out and making known the exact conditions of work that give the best possible result from the economic and hygienic standpoint. The scientific and technical Press is in a particularly happy position to act as a channel for the dissemination of such knowledge. We therefore will look to Mr. Rowntree for information, and for suggestions as to how we can best serve the movement under his direction.

Mr. Rowntree's long experience of this work will be known to many of you. Even before the war he was identified with the study of the welfare of factory workers, and had introduced in his own business the essential principles of what is known to-day as welfare work. This past experience has enabled him to render inestimable services to the country at the Ministry of Munitions, and we are indeed fortunate in welcoming him here to-night.

THE HUMAN ELEMENT IN FACTORIES.

By B. S. ROWNTREE.
Director of the Welfare Department, Ministry of Munitions of War.

(Paper read before a meeting of the Circle of Scientific, Technical, and Trade Journalists, held in the Hall of the Institute of Journalists, London, at 5 p.m. on November 14th.)

I WAS asked to speak on "Welfare Work in Factories," but instead of adopting that title for my address I chose "The Human Element in Factories," for welfare work may be defined as the humanising of industrial conditions.

As I travel about the country I am impressed by the fact that whereas very many employers recognise fully that their responsibility to their workers extends far beyond the bare observance of the Factory Acts, and the payment of the rate of wage current in the locality, others contend that they see no need to do more than fulfil these two conditions. "Business is business," they tell you. "The workers care nothing for us, why should we bother about them?" And so they frankly treat their workers as impersonal dividend-producing machines. Are they happy or unhappy, well or ill, anxious or contented, matters not so long as they can do their work; and after all, if they don't or can't do their work there is always the remedy at hand, and others ready to take their places. Having definitely adopted this attitude towards the workers, they not infrequently proceed to complain bitterly of their behaviour. "They break time shockingly, and with utter disregard to the importance of the work." "They waste material." "They are for ever grumbling; their sole aim is to get as much as they can for doing as little as possible. They strike on the least provocation, or without provocation, and merely at the bidding of some agitator. In short, they are a lazy, shiftless lot."

Now in certain factories there is much truth in many of these charges. But what a terrible waste of that precious commodity, human effort, this indicates. To think that men should be idling when England is fighting with her back to the wall!

I suppose there never was a time in our national history when there was greater need for every one of us to do and be his best, and for the elimination of waste. "Don't waste gas, coal, or electric light," is an admonition placarded over the London hoardings in letters 4 feet high. "Don't waste human effort" is an admonition much more urgently needed. And not needed to-day only. It will be needed for long years to come, when we are engaged on the unromantic and uninspiring task of paying a war bill of no one knows how many thousand millions.

And so we come to this. Present conditions have forced upon us the fact that if the nation is to prosper, human effort, the basis of prosperity, must be economised. By this I do not mean, of course, held back, but used to the best possible advantage.

The wheels of the industry must be greased, for truly our industrial system is a groaning, creaking machine, and much in need of oil.

I do not propose here to discuss fundamental changes in it, their consideration falls outside the scope of welfare work. But I want to make it clear that no method of conducting industry is satisfactory which leads to a waste of human effort, and that unless workers are happy and contented and well, they do not and cannot put forth their best efforts.

Briefly, welfare work aims at making the workers happy, contented, and well. Not, mark you, by fair words and tinsel rewards given in lieu of the more substantial rewards for effort which trade unions demand, but by providing such conditions of industry, and showing such consideration for the workers as naturally call forth effort. This, of course, includes rewarding effort suitably—or, in plain business language, paying good wages. Welfare work and sweating wages are like oil and water: they won't mix.

And now let me seek to define more precisely what I take welfare to involve. I have already referred to wages. I think it will be agreed that the minimum aimed at should be wages sufficient to provide what is necessary for physical efficiency and to leave a reasonable

margin for recreation. I do not propose to quote figures. I have done this elsewhere, but I maintain that the employer should seek to satisfy himself on this head, and should regard the conditions in his factory as essentially unsatisfactory until at least this minimum has been reached. And here I would urge that what is of importance to the workers is not the wage rate, but the sum of money actually taken away week by week. Care should be taken to avoid standing individuals off work for such periods that the wages they take home at the week-end are insufficient for the maintenance of physical efficiency. It is really astonishing how some employers stand workpeople off without paying them, without apparently recognising the hardship involved, or making any adequate effort to regularise employment. The evil of this practice is magnified when workers are living away from home; and in the case of girls living in lodgings, the temptation to earn money in other ways is obvious.

Another fundamental condition of well being is that the length of the working week should not be excessive. The working day should be of such total length and so divided up by rest intervals as not unduly to tax the workers' strength, and it should give reasonable opportunities for rest and recreation. In no case should the hours be more than recommended by the Health of Munition Workers' Committee, and if a shift is as long as five hours it should be broken by a brief rest interval. Accurate statistics of the wastefulness of excessive hours of work are very difficult to obtain, owing to the instability of working conditions, which make comparison of output during periods of short hours and long hours unreliable; but there is a growing concensus of opinion that long hours, especially if continued for a considerable period, do not pay the employer. In this connection it is important to remember that once the human organism becomes run down it takes much longer to rebuild the worn-out tissues than to wear them out; the Health of Munition Workers' Committee has recently pub lished a memorandum giving the result of a detailed and careful inquiry which they have made into the matter. They give various illustrations of the economy of short hours. For instance, they show how, in one munition factory, a reduction in hours, from 77¼ to 66½ per week, resulted in an increased hourly output of 23 per cent. in the case of female workers; and they say in regard to this case that the evidence pointed to 60 hours per week as being the maximum number of hours which can be worked with advantage. In another case the hourly output of men increased by 22 per cent. when their hours were reduced from 71 to 61 hours per week.

A third factor of great importance in the well-being of the workers is that there should be adequate facilities for securing nourishing food under restful and wholesome conditions. When considering the energy put into their work by factory employees, it is sometimes forgotten that, as Walker, the American economist, pointed out, there is only one way of getting energy out of a man, and that is by first putting it into him. If a man's food is adequate his work may be mighty; if he is underfed he must underwork. And yet not a few employers regard the provision of nourishing food in suitably furnished canteens as a luxury. It is no more of a luxury than is the stokehole of the boiler-house. And let it be remembered that it is not sufficient just to put the necessary amount of nutriment into the man or woman. The dinner hour should be spent under agreeable and restful conditions. To eat a cold or heated-up meal, sitting by one's machine, in a close or dirty workroom, is not the way to secure a good afternoon's work. Clean and wholesome workrooms, well lit, and well ventilated, and work suited to the capacity of the worker are other conditions both of welfare and of efficiency. Thus stated the fact would appear to be obvious, and, yet it is one which is frequently overlooked in practice. We know in our offices that if the light is trying, or the air is close, we cannot do our best work, and yet how ill-lit and ill-ventilated are many workrooms! And again, how often men and women are put to work for which they are not suited.

This leads me to another important matter, namely, the method of selecting employees. It seems to me that employers do not sufficiently realise how

critical a process of industry the "setting on" of a worker is. This is true of all workers, but especially of women and boys. Imagine girls or boys introduced for the first time into a large factory! They should first be led to realise the great possibilities that lie before them, and then surrounded by conditions which will enable them to realise those possibilities. Engagement should always be by a sympathetic person, with the gift of inspiration, who should keep in touch with the workers after engagement, with a view to supplying the sympathy and stimulus which encourage them to do their best. For a foreman to pick a boy or girl out of a crowd and send them to work in a merely mechanical way, without any recognition of the fact that the human mechanism is extraordinarily sensitive and responsive to external stimuli, is not the way to economise human effort. I said earlier on that for men and women, and especially boys and girls, to put forth their best efforts they must be happy, contented, and well. To achieve this end they must be treated and considered individually, and not in the mass. Rough justice for a large factory staff may comprise a great many minor cases of injustice, and each one of these militates against the efficiency and output of the person affected. A foreman giving to nagging or bullying is the worst investment an employer can make. As has been well said, "In business hearts, not clubs, are trumps."

How is this individual attention to employees to be secured? In the old days, when industry was conducted in small units, and the employer knew his workers individually and called them by their Christian names, there was a human bond of relationship between master and man. Now, with enormous factories employing thousands of men and women, this bond has largely disappeared. The directors base their policy largely on financial considerations, and the workers tend to become only pawns in the financial game. It is obviously impossible for a large employer, however much sympathy he may feel with them, to know his workers individually, and that is why employers have introduced into their factories what are often known as welfare departments, staffed by carefully selected men and women, whose duty it is to seek to introduce into the business organisation that human touch which is so apt to be squeezed out in the huge industrial concern of to-day. The staff of the welfare department usually engage the workers, or at any rate assist in doing so, possibly leaving the ultimate choice to the foreman or forewoman; they keep records of broken time, and seek to remove its causes; they investigate cases of dismissal and resignation of employees; they hold a watching brief over the wages, and advise the management where any case of injustice or anomaly seems to exist; they investigate complaints made by the workers; they supervise the working conditions, and, especially where poisonous or dangerous materials are handled, seek by every means to safeguard the health and safety of the workers; they supervise the canteens and rest-rooms, and where workers are imported from a distance they help in finding suitable lodgings. In short, they seek not only to secure good working conditions, but to show consideration to each individual worker. They are not concerned, as a rule, with technical processes or output, though obviously if they succeed in creating a spirit of contentment and good-will their work affects output very greatly.

Hundreds of such welfare supervisors have been appointed since the war began, and many an employer can testify to the value of their services. Of course, there have been failures. It is obvious that in work of this kind everything depends on the personality of the officers appointed, and where the choice has been unfortunate the work has suffered accordingly. But the failures have been few in comparison to the successes. I have seen the whole character of a working staff revolutionised through the tactful activity of a welfare department. Only the other week I went over a large factory where a couple of thousand women were employed—many of them on most unpleasant and dangerous work—and yet there was throughout the whole place a striking spirit of good-will and contentment. I learned the secret of this in the course of an hour's talk with the head welfare supervisor, who told me of the care taken to secure the best

possible working conditions, and of the individual attention paid to the workers. She told me of the great benefits which had been derived from the appointment of refined and sympathetic women as supervisors.

The following is a summary of the work carried out :—

(1) The engagement of women, and recruiting labour from the Labour Exchanges.

(2) The supervision and care of the overalls used by workers.

(3) The appointment of twelve carefully selected welfare supervisors.

(4) The consideration of all complaints and the checking of all dismissals.

(5) The work of the hospital, where there are up to 800 cases per week, and of the dentistry department.

(6) The constant supervision of health precautions.

(7) The supervision of canteens, cloakrooms, etc.

Before I close, I should like to take the subject of humanising factory conditions a stage further, and speak of what I believe is to be the next step in the evolution of industry. Hitherto the position of employers and employed has been almost purely that of master and servant, and yet, when one comes to think of it, there is no reason why this should be so. The employer either provides or represents capital, but his capital is valueless without labour, just as labour is valueless without capital. To make either effective they must come together and work in co-operation. Why should they not work in a spirit of partnership ? Is there anything to prevent the realisation of the ideal outlined by Mr. Gosling in his presidential address to the recent Trade Union Congress, where he said : " We hope for something better than a mere avoidance of unemployment and strikes. We are tired of war in the industrial field. The British workman cannot quietly submit to an autocratic government of the conditions of his own life. He will not take ' Prussianism ' lying down, even in the dock, the factory, or the mine. Would it not be possible for the employers of this country, on the conclusion of peace, when we have rid ourselves of the restrictive legislation to which we have submitted for war purposes, to agree to put their business on a new footing by admitting the workmen to some participation, not in profits, but in control ? We workmen do not ask that we should be admitted to any share in what is essentially the employer's own business—that is, in those matters which do not concern us directly in the industry or employment in which we may be engaged. We do not seek to sit on the board of directors or to interfere with the buying of materials, or with the selling of the product. But in the daily management of the employment in which we spend our working lives, in the atmosphere and under the conditions in which we have to work, in the hours of beginning and ending work, in the conditions of remuneration, and even in the manners and practices of the foremen with whom we have to be in contact—in all these matters we feel that we, as workmen, have a right to a voice—even to an equal voice—with the management itself. Believe me, we shall never get any lasting industrial peace except on the lines of industrial democracy."

Up to the present, employers have tended to keep the workers at arm's length in all questions of management. " If I can't be master in my own business, it is about time I shut up shop," has been their attitude. I am confident that it is a wrong one, and it must be changed if we are to be successful in the intense industrial competition to which we must look forward in the future. There have been many signs in the past decade that English workmen, with their growing education and width of outlook, will not much longer be contented to be mere wage slaves. The industrial conditions of the last two years have made them see clearly how indispensable are their services to the community, and they will claim a more responsible part in determining the industrial conditions of the future. It will, I believe, be a profound mistake for employers to hold the trade union at arm's length, and to resent all suggestions that the workmen should have a say in determining, not the financial policy of business, but the conditions of work. It will not weaken, but strengthen, British industry to have this closer co-operation.

Let us say to the workmen: "Come and help us in a spirit of partnership to solve the day-to-day problem connected with the conduct of our business." We will establish Works' Councils on which workers and management shall be equally represented. Since the decision of these councils might occasionally be incompatible with the financial policy of the business, the management, who are ultimately responsible for finance, must retain a vote over them; but, on the other hand, the trade unions may discuss with the management any decision come to by the Works' Council not satisfactory to them. There is nothing in this suggestion which need alarm either capitalists or trade unions, but the frank recognition that the workers within certain limits are regarded as partners rather than servants at once raises their whole status. The existence of Works' Councils, where all kinds of questions of management can be frankly discussed and suggestions received from the workers for overcoming difficulties, will do much to break down that suspicion which leads not only to serious industrial unrest, but which checks output and lowers efficiency.

I should like, if I may, to conclude with a quotation from a remarkable book by an American writer named "Redfield," entitled *The New Industrial Day*. Speaking of the human element in industry, he said:—

"With the men that enter our factories, enters the greatest force in all production, I mean the responsiveness of these men to leadership. They work indeed because they needs must earn their bread, and it is needful that supervision should be closely exercised for manifest reasons, but neither the need for bread nor the closest supervision will draw out the best that the workman has to give. That can only be done by the righteous adjustment of wage to product; by the absence alike of injustice and of charity; by the opening of the door of opportunity; by the absence of driving and the presence of leading; by the selection of the man for the task, and the adjustment of the task to the man; by the instruction of the man for his task or, if unfitted for it, then in some other task for which he is more fitted; by the spirit of candour and frankness between the employer and the worker; by the willingness to hear and to wait; by the closest possible touch practicable in great factories between the management and the working force. It has been said that corporations have no souls; this is a pity, if true, for the men in the shop have souls, and the coming in to the minds and hearts of the men that run the corporations of sufficient soul to give them a basis for appeal to and co-operation with the souls of men at the machines may make the difference between profit and loss to the corporation."

Since I took up my work at the Ministry of Munitions it has become increasingly clear to me that the work of the Welfare Department is largely one of education. I have come across manufacturer after manufacturer to whom the views I have placed before you are a new gospel. Some of them receive it with gladness, some with suspicion, and some with opposition—the opposition of the man who is firmly convinced that what was right for his grandfather cannot be wrong for him. The suspicious men, and those who are at first in opposition to us, do not really lack sympathy; but from one reason or another they have got into a rut, which has proved to be a grave to modern ideas. Most of them, I feel sure, can be persuaded in time to humanise the conditions in their works, but they must be *absolutely convinced* that this is the right thing to do before they change their methods. It is impracticable for my department to conduct the necessary educational campaign by means of individual conversations. What is needed is the creation of a public opinion throughout the country, which regards the impersonal and mechanical method of dealing with workers as out of fashion and unwise, and which demands a more human relationship between employer and employed.

I am here to ask you to help me in the creation of this public opinion. You have opportunities for doing this which no one else possesses. It is a great work to undertake, and may have far-reaching influences, not only on the health and happiness of countless thousands of workers, but upon the success of British industry in the period of intense competition which undoubtedly lies ahead of us.

DISCUSSION.

Before declaring the discussion open the CHAIRMAN (Mr. L. Gaster) read a number of letters received, expressing interest in Mr. Rowntree's paper, and regret at inability to be present:—

Viscouut HALDANE:—

"I wish I could have been present on the 14th to hear Mr. Rowntree's paper, but a public engagement will detain me elsewhere.

"The subject is a very important one from the point of view of the training of the future generation. The work at the Ministry of Munitions in which Mr. Rowntree is engaged is of special importance."

The Rt. Hon. ARTHUR HENDERSON, M.P.:—

"I desire to acknowledge the receipt of your letter of the 31st of October, and to express my regret that the pressure of official duties prevents me from being present at the meeting of the Circle of Scientific, Technical, and Trade Journalists on Tuesday.

"Mr. Rowntree's work as Director of the Welfare Department of the Ministry of Munitions needs no recommendation. That work marks a definite departure from the view which has too often held the field, viz., that the physical well-being of his workers was no concern of the employer. From this vicious principle Mr. Rowntree broke away, and the results of his labour at York have proved an object-lesson to all employers of the present day.

"The Welfare Department of the Ministry of Munitions is doing work of incalculable value to the future well-being of our country.

"I trust you may have a successful gathering."

Sir WILLIAM LEVER:—

"I know of no one who can better address the meeting on this subject than Mr. Rowntree. He and his firm have done so much for the welfare of their staff. The whole basis of welfare work consists in the employer doing something for the benefit of his staff that they cannot do for themselves. Only the employer can provide within the precincts of the factory the arrangements on which their welfare depends. Such arrangements do not entail great capital expense, but they do involve some little thought. Whatever capital and thought are so expended will be amply repaid by the improved health, efficiency and happiness of the staff."

Mr. H. GORDON SELFRIDGE:—

"In this subject I take a great interest. One of the great underlying principles of management of large bodies of employees is to treat them with fairness and justice, and also with that kindly and reasonable consideration which the manager would himself hope for if he were in the place of the employee. Labour which is won through fear is half-hearted, but that which is won through love and respect is genuine and sincere, and if the staff is led by inspiration it will give more nearly 100 per cent. of its possible efficiency than when controlled by any other method."

Sir RICHARD BURBIDGE (Managing Director, Harrods Ltd.):—

"I very much regret that a prior engagement prevents my hearing Mr. Rowntree's paper. Welfare work is always of great interest to me, and I am convinced that any time and thought given by the employer to studying the well-being of workers is amply repaid by increased efficiency. It may be interesting to you to know that we consider the health and comfort of our employees in a very practical way. There are well-lit dining-rooms, comfortable rest-rooms, permanent nurses' rooms, and a visiting doctor and dentist are provided. Some five years ago a training scheme was instituted, and employees are given time off during the day to attend classes. By analysis of the common error we are able to provide classes in the subjects which are most needed."

Mr. A. G. GARDINER (Editor of the *Daily News* and President of the Institute of Journalists):—

"The subject is one of supreme importance at this moment, and I congratulate your Circle on the advantage of being addressed by the highest authority on the question. I sincerely trust you will have a profitable discussion."

The Rt. Hon. DAVID LLOYD GEORGE (Minister of War)

"regrets that owing to great pressure he is unable to be present at the meeting."

Mr. MONTAGU (Minister of Munitions)

"regrets that his engagements will prevent him from being present. He is sure, however, that Mr. Rowntree's well-known authority on the subject with which he is to deal will secure the success of the meeting."

Sir GEORGE NEWMAN (Chairman of the Committee on the Health of Munition Workers):—

"expresses thanks for the invitation, but will not be able to attend, as he is absent in Scotland on official business."

Among others interested in the subject who had been invited to the meeting, but had been unable to be present, may be mentioned: The Home Secretary, Sir Arthur Whitelegge (H.M. Chief Inspector of Factories), Sir George Riddell, Mr. G. H. Roberts (Labour Adviser to the Board of Trade), Mr. C. W. Bowerman, M.P., Sir Hedley le Bas, Mr. J. L. Garvin

(Editor of the *Observer* and President Elect of the Institute of Journalists), Sir James Yoxall, Sir Henry Trueman Wood, Dr. Chas. Carpenter, Mr. Arnold Bennett, Mrs. Sidney Webb, Mrs. H J. Tennant, and Miss R. E. Squire.

The CHAIRMAN (Mr. Gaster) after referring in appreciative terms to Mr. Rowntree's interesting paper, added that he would like to endorse Mr. Rowntree's remarks regarding the value of good lighting in factories, that being a subject in which he was personally concerned. This question had received insufficient attention for many years, but in 1913 the Home Office appointed a Departmental Committee to inquire into the matter and, in spite of the war, had issued a preliminary Report in three volumes, which was certainly far ahead of anything published hitherto. This report had received the attention of the Committee on the Health of Munition Workers, and had been endorsed in the bulletins issued by this Committee. Thus, the question of lighting was looked upon as a very important one in welfare work because it had been clearly shown that good lighting was influential in increasing the output and diminishing the number of accidents.

Mr. A. J. MUNDELLA (Chairman of the London of the Institute of Journalists), who proposed a vote of thanks to Mr. Rowntree, agreed as to the great importance of welfare work. The chief question was how to obtain and train welfare workers. He was confident, however, that under Mr. Rowntree, with his great experience in this direction, a real team of efficient workers would grow up. It was a great sacrifice and very noble of him to place himself at the disposal of the Government in this matter, and journalists should now come forward and do a little bit more towards the progress of the welfare movement than they had been doing hitherto.

Troubles and misunderstandings between workmen and employers were frequently exaggerated in the newspapers, and difficulties were thus placed in the way of an amicable settlement. He hoped that Mr. Rowntree's eloquence and impressive explanation of the situation would encourage journalists to try to put a little more imagination into this matter in order to help to bridge over the chasm between employer and employee.

Mr. GILBERT WOOD (Vice-President of the Institute of Journalists), who seconded the vote of thanks, said that although they had not all seen eye to eye with Mr. Rowntree, or rather with the suggested movement, in the past, the position as it had been explained by Mr. Rowntree indicated that this difference of opinion was very often due to ignorance.

It was clearly desirable to educate the employer but at the same time the employees also had to be educated. As an instance of this, he mentioned that as far back as 25 years ago a big firm of printers suddenly came to the conclusion that their place was unhealthy and decided to make improvements; an expensive system of ventilation was put in, but the employees did not recognise its value and within a week the whole of the ventilators were stuffed up and the place was more unhealthy than it was before.

With regard to the class of employer who said that what was good enough for his grandfather was good enough for him, unfortunately that type of man nowadays often did not even go through the works as did his grandfather, but went to a university instead and came back to take control of a business of which he knew nothing. It was impossible for a man of this type to realise what was necessary for the benefit of the workpeople and the difficulties with which they had to contend. Therefore, the welfare movement must aim at making the welfare supervisor fill the place of the master in such matters, introducing the element of personal contact that was characteristic of relations between master and man in the old days.

Mr. A. T. DALE, as an employer who had at one time 5,000 men working for him, agreed that the old personal contact between master and man, when most of the employees were called by their Christian names, led to better relations between them than did the present conditions of large factories in which the employers could not possibly know their workpeople. Everything should be done

to create good feeling not only between the employees and the employers, but amongst the employees themselves and it was in this direction that welfare work must play an important part.

Mr. G. BELLHOUSE (Factory Dept., Home Office) said Mr. Rowntree in his work at the Ministry of Munitions was laying the foundation for a system which must be a permanent feature in the future. The conditions years ago when factories were small were very different from those of the big joint-stock companies of to-day, and it was becoming more and more necessary for welfare work to be developed in workshops and factories.

One of the chief points in Mr. Rowntree's paper was the need for education. He was quite satisfied that if this work was going to be a success a vast amount of education would have to be carried out. It was necessary to educate the employer, because there were no doubt some employers who looked upon welfare work as "philanthropic rot." Then it was necessary to educate the welfare superviser, because it was not practicable to put any man or woman to this work without proper education. The work required infinite tact, for the supervisor had to act in a sense as a go-between between the employer and operative without representing either, and must obtain the confidence of both.

Then it was necessary to educate the operatives because at the present time some were looking with considerable suspicion upon welfare work. They did not quite know what it all meant and argued that if the employer put a welfare supervisor in the works at a salary of £250 a year he must be getting something out of it and out of themselves. That arose from a misconception of the real nature of welfare work. To counteract such impressions it was necessary to create a public opinion in favour of welfare work; otherwise it might become unpopular and even a failure. There was little doubt that welfare work had received during the war a stimulus such as it had never had before, and Mr. Rowntree was one of the principal agents who had brought this stimulating influence to bear.

Mr. E. H. PELHAM, Secretary of the Committee on the Health of Munition Workers, regretted that the Chairman of this Committee had been prevented from being present. He would like to say, however, that great credit was due to Mr. Rowntree for initiating the work done in this direction.

Mr. A. P. M. FLEMING said that there were two aspects of welfare work—one was materialistic, and the other, for want of a more appropriate term, might be called the ethical aspect.

By the materialistic aspect he referred to the preparations made for improving the well-being and physical comfort of the worker such as had been set forth in the paper. In this connection he would refer to those researches relating to the physiological and psychological conditions governing fatigue, and which relate to the efficiency of workers. Considerable work had already been done in this matter and discussed at the last two meetings of the British Association, and he hoped that a great deal more research work of this character would be carried out in future, since it afforded the most promising means of solving scientifically problems that are at present attempted by mere guess work.

By the ethical aspect, he had in mind the development of an inherent desire on the part of workers for improved hygienic and environmental conditions in factories in place of a complacent acceptance, which at present prevails on the part of a large mass of workers of any conditions—good or bad—in which they find themselves. The time at which to start the development of the ethical side of welfare work is not with the adult worker, but with the boy or girl just prior to, and for a few years subsequent to, leaving school, for while much can be done to develop good habits in adult workers by suitable environment, it must be remembered that in many industries such workers are often migratory, and the good effects of a well-equipped factory are readily lost. In particular, attention paid to the development of the social interests of boys by encouraging sports and other social activities, is likely to have far-reaching effects in imparting a desire for suitable working environment.

Dr. E. L. COLLIS, also a member of the Committee, spoke in terms of admiration of Mr. Rowntree's work. He mentioned, as an instance of the value of personal interest in employees, the case of a young foreman whom he met again after eight years but did not recognise. It appeared, however, that some words of encouragement of his given to this young man eight years before had remained in his mind and served him in good stead, for he had made rapid progress and had been made foreman at a very early age.

Miss L. E. PATTERSON said she had been immensely struck during a tour of factories by the enormous influence of the women supervisors on the girls and women. They were quite willing to come to the supervisor and state any grievances, and had found her of the greatest service to them. This welfare work was of niestimable benefit in munition factories, where she had found the women workers were extremely happy. Similarly the hostels were admirably organised. In one instance there was a woman doctor who told her that not only did the work-people come to her for advise in the ordinary way at the works, but they also consulted her on many of their worries and troubles in home life.

Miss A. A. SMITH, who had also visited a large number of factories in company with Miss Patterson, expressed her admiration of the great influence exerted, not very demonstratively, but absolutely and sympathetically by the lady supervisor in charge. It gave her great pleasure also to hear Mr. Rowntree and the other speakers recognise the very great service that had been done by women in public life. But would Mr. Rowntree sweep away the impression which had gained ground in certain quarters that the assistance of the welfare worker was being paid for out of the employees? Also would he state whether there were as many men welfare workers as women and were the women welfare workers paid equally with the men?

Mr. S. R. LITTLEWOOD spoke of an instance of conflict of interest between those responsible for the erection of a picture palace in connection with one of the large munition factories and the local Y.M.C.A., who looked upon this step with disfavour. At the same time it frequently happened that when there were no such picture palaces an enormous number of young people who were now at work on munitions flooded into the towns and were without any means of recreation at all.

Miss BRIDEY O'REILLY said that many educated women suitable for the post of welfare supervisor were unable to accept the positions on account of the length of hours which many employers seemed to think they should work. They were, however, quite willing to work half the number of hours for half the salary. Would it not be possible to appoint two supervisors to cover the factory hours, one working, say, from 7 a.m. to 1 p.m., and the other from 1 p.m. to 7 p.m.?

The vote of thanks was then put to the meeting and carried with acclamation.

Mr. ROWNTREE, replying briefly to some of the points raised, dealt first with the education of employees as to the advantages of welfare conditions. He quite agreed that this education is necessary, but it was most important that they should not expect gratitude from the workers. Welfare conditions were really not charity. They were nothing more than a fulfilment of the reasonable responsibilities of the employer, and if those interested entered upon the work with the idea that they were particularly virtuous persons and expected gratitude from the employees they were bound to be disappointed. Nevertheless, the education of employees was necessary to enable them to appreciate these things, and it was quite as important as the education of the employer.

With regard to sweeping away the idea that the welfare supervisor was paid out of the wages, he knew that the work was looked upon with a considerable amount of suspicion by trade union leaders who thought it was an attempt to side-track trade unionism, and to give the workers little lollipops and presents in place of substantial rewards for their labour. It

was, however, very important indeed that it should be understood that it was nothing of the kind. This was not an attempt to interfere with the organisation of labour, and had nothing whatever to do with any attempt to pacify workers, and get them to be contented with conditions which were unsatisfactory. Some of the employees had the feeling that the supervisor was paid out of their wages, and was put into the works merely in order to get more work out of them, but that, of course, was not the case.

Welfare supervision had not been introduced to get more out of the workers. It was based primarily on the idea that the men and women employed must have their conditions of employment considered, and although incidentally it had been found that this consideration for their employees paid the employers, yet he was sure it had not been primarily introduced because it paid. On the other hand, it was not done as philanthropy, but merely as a piece of business organisation.

With regard to men supervisors and their salaries, he had plenty of vacancies, but unfortunately nearly all the men were engaged in France. He could place a dozen good men to-morrow if he had them, and if any one knew a good man would they send him along to the Ministry of Munitions? With regard to salaries, broadly speaking, they were about on the same scale for the women as for the men, although he knew of one case where the head woman supervisor got exactly double the salary of the head man.

The need for recreation mentioned by Mr. Littlewood was a very important matter, and he was glad it had been mentioned because the whole question of recreation was now being dealt with by the Welfare Department at the Ministry of Munitions. They had already begun to organise in certain munition centres recreation. They were encouraging the people to provide their own recreation and entertainments, and he discouraged the idea that they should have ready-made entertainments flung at them. He hoped that would be developed on an extended scale.

As to length of hours for the supervisors, that was really a matter which each employer must determine. It was a condition of employment which he must make with the supervisor. What he thought was reasonable was that these supervisors should work what he would call office hours. The work of the welfare supervisor was very arduous, because he or she was always giving out sympathy, and there was nothing more wearying than that. It certainly could not be done for twelve hours on end, and he therefore suggested office hours, whatever they might be according to the district. Many employers did expect the welfare workers to keep the same hours as the factory employees, but he considered these were often too long.

As to having two people to work through the day, he thought that such a scheme would result in them being looked upon as amateurs. The girls would say that if they could "stick" twelve hours of it, there was no reason why the welfare supervisor could not, and on the face of it that was a sound criticism.

He was glad that Mr. Bellhouse had supported the work. He wished to make it clear that the ideas he (Mr. Rowntree) had been putting forward had not originated with himself. He was merely the humble agent of others who wished those ideas put forward, but they would not fructify throughout the length and breadth of the land unless there was a public opinion which demanded this attitude on the part of employers towards their employees. The Home Office could not do it, the Health of Munition Workers Committee could not do it, and the Ministry of Munitions could not do it. They could, it was true, send a travelling inspector down to speak to any particular employer, and that might make a little bit of impression.

But the only way to do it thoroughly and universally was by getting a public opinion throughout the country, and the only people who could do this were those with influence in the Press. If the Press demanded that such an attitude should be displayed by employers, it would be an enormous help. Therefore, he most earnestly asked those who had power and influence in the Press to develop the right atmosphere for such ideas as he had had the privilege of putting before the meeting.

TOPICAL AND INDUSTRIAL SECTION.

[At the request of many of our readers we have extended the space devoted to this Section, and are open to receive for publication particulars of interesting installations, new developments in lamps, fixtures, and all kinds of apparatus connected with illumination.

The contents of these pages, in which is included information supplied by the makers, will, it is hoped, serve as a guide to recent commercial developments, and we welcome the receipt of all *bona-fide* information relating thereto.]

A NEW BRITISH INDUSTRY.

Heat-Resisting Glassware for Lamps and Lighting Appliances.

During this year **Messrs. Chance Brothers and Co., Limited** (Glass Works, near Birmingham), have devoted much energy to establishing in their works the manufacture of glass of heat-resisting qualities, such as is required for globes for intensive lighting, and which, previous to the War, were only to be obtained from enemy countries. In taking up this entirely new branch of the glass trade, Messrs. Chance were influenced chiefly by the urgent representations made to them by the Board of Trade.

We understand that they have succeeded in making a glass similar to the Jena glass, and are to-day sending out globes which are proving in every respect equal to, or better than, the German product, and that they are now seriously going into the trade on permanent commercial lines.

Z ELECTRIC LAMPS.

An attractively-got-up pamphlet has been issued by the **Z Electric Lamp Co., Ltd.** (Southfields, London, S.W.). In the introduction it is pointed out that the War has shown the necessity of this country being self-supporting in vital supplies, such as lamps and accessories for artificial light; since the outbreak of War there has been an increased demand for British goods of this kind.

B.T.H. INCANDESCENT ELECTRIC LAMP HANDBOOK.

The Incandescent Electric Lamp Handbook (No. 1), now issued by the **British Thomson-Houston Co., Ltd.**, is of a handy pocket-size, and contains a great deal of useful information. Illustrations of all the chief lamps (one-third full size) are shown on the left-hand pages, with corresponding particulars of wattage, candlepower, size of bulb, etc., facing them on the right hand. There is also a complete list of definitions of terms used in the incandescent lamp trade.

The list includes an explanation of the "Lumen," and it is pointed out that there is a growing tendency to describe the performance of a lamp in terms of "lumens per watt" rather than "watts per candle." We notice that throughout the booklet values in lumens as well as watts per candle are given, while the general table of candlepower values (p. 14) gives the watts, watts per candle, mean hor. candlepower, total lumens, lumens per watt, and spherical reduction factor. The booklet is completed by particulars of the dimensions of standard lamp caps, both of the screw and bayonet type.

SEARCHLIGHT PROJECTORS.

The latest list of searchlight projectors issued by Messrs. Crompton and Co. contains evidence of the rapid developments in this field. Some of the most interesting developments, however, naturally cannot be referred to at the present time (we notice, for example, the omission of several illustrations in deference to the Defence of the Realm Act).

Of special interest are the constant improvements being made in appliances for the manipulation of searchlights and their elevation in different directions. We observe in this list rows of 24 in. anti-aircraft projectors and compact forms of motor field service equipment. A convenient form of mobile projector is shown in Fig. 2. Among the various special attachments may be mentioned motor-controlled flashing shutters, Parsons Split Mirrors, cable carts, petrol generating sets, &c.

While most of the illustrations naturally refer to types of searchlights specially adapted to war requirements it is of interest to note that they have many other special applications in peace both for marine work and on land. Small projectors, for example, may be fitted to river steamboats, and, as Fig. 3 suggests, searchlights are often useful for facilitating night operations in mining work.

We notice that reference is made to "the absence of any recognised standard as a basis of comparison for the effective range" of searchlights, and the view is expressed that the relative merits of searchlights cannot conveniently be expressed in terms of candle-power. We recognise the difficulties, but it is surely desirable that some common method of expressing the illuminating effect on a distant object should be available. We hope that manufacturers will not overlook this possibility. This matter deserves closer investigation. Considerable progress in the desired direction has already been made and the problem may prove less difficult of solution than is commonly supposed.

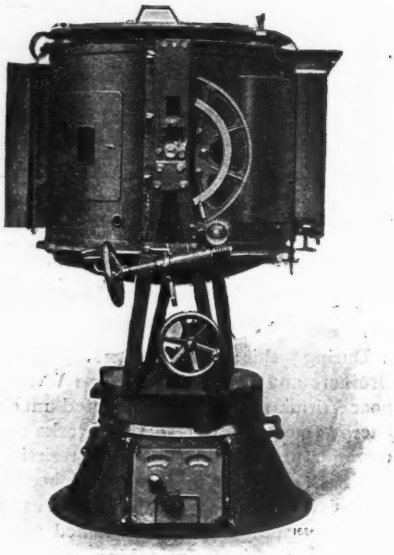

FIG. 1.—Anti-Aircraft Projector.

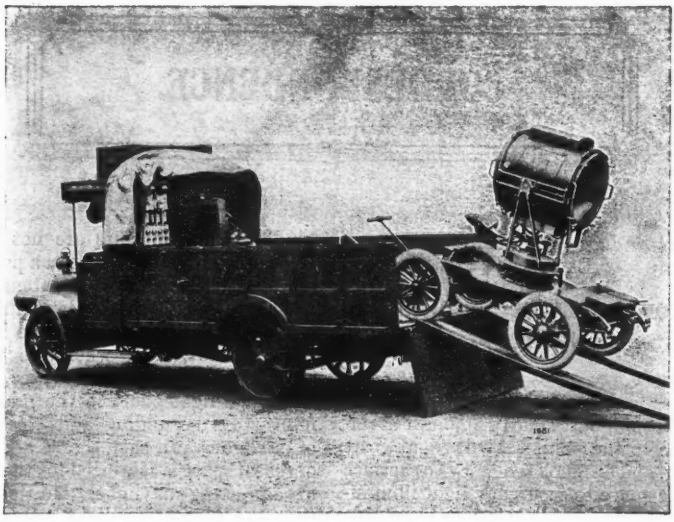

FIG. 2.—Complete Mobile Projector Equipment.

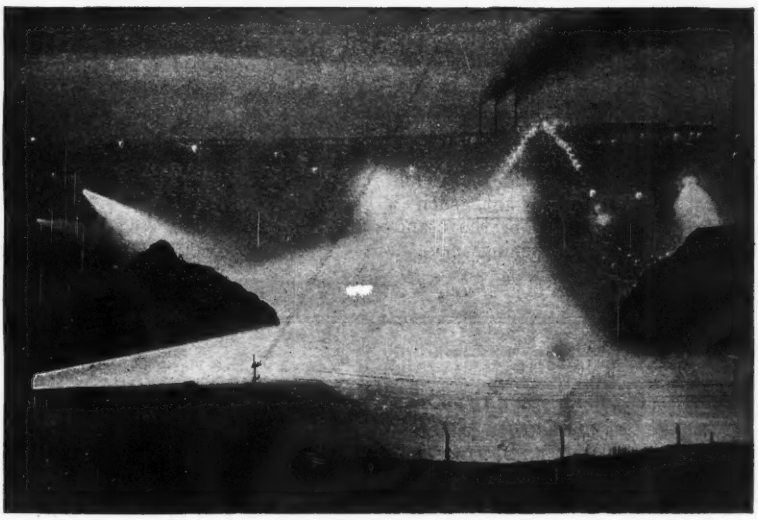

FIG. 3.—Projectors for Night Operations in Mines.

CORRESPONDENCE.

To the Editor of the ILLUMINATING ENGINEER.

COST OF DAYLIGHT *vs.* ELECTRIC LIGHT.

DEAR SIR,

There seems to be so much misapprehension, particularly amongst architects, as to the point that daylight costs nothing, and so much tendency to sacrifice valuable space to secureday light illumination when artificial lighting could provide illumination far more effectively and cheaply, that I would like you to give me sufficient space in your columns to publish the following letter written by Mr. M. Luckiesh of the Laboratories of the National Electric Lamp Association of Cleveland, to the *Lighting Journal* of New York.

"In lighting discussions it is not uncommon to hear such statements as this: 'A great virtue of daylight is that it costs nothing.' Outdoors this is usually true, but in the vast field of human activities where artificial light aids and competes with natural light, such a statement is absurd. From the standpoint of construction, openings such as windows and skylights are not costless In other words, interest upon a permanent investment as well as a maintenance cost must be charged to the daylighting, and therefore at once it ceases to be free from cost. Furthermore, when the value of land, especially in large cities, is considered, a light court in the middle of a multi-storied building adds to the cost of daylight. In such a case a large area of rental space is sacrificed for the purpose of admitting daylight, and it appears that the cost of daylight would not be inconsiderable. Of course, light courts provide ventilation, but it seems possible that ventilation could be provided without such a great sacrifice of space.

"The discussion could be carried further to the consideration of valuable wall space in stores where rental prices are high, and possibly even in factories.

"By no means is this comment designed to suggest the abolishment of daylight even in cases where it might be found too costly, but rather to suggest that some architect, who may have figures available, favour us with a discussion of the cost of daylight."

Yours, &c.,
F. W. WILLCOX.

ROYAL SOCIETY OF ARTS.

SESSIONAL ARRANGEMENTS.

The programme for the coming session contains many interesting items. There are lectures on such subjects as "The Economic Development of Russia," "The Coal Tar Industry," "Classical and Scientific Education," "The World's Cotton Supply," "German Business Methods," etc. The Howard Lectures are to be delivered by Prof. J. S. S. Brame, on "Coal and its Economic Utilisation," and by Professor W. Ripper on "Works Organisation and Efficiency." The Cantor Lectures will be by Prof. Beresford Pite on "Town Planning and Civic Architecture."

REVIEW OF BOOKS.

Spon's Electrical Pocket Book, by W. H. Molesworth. (*Messrs. E. and F. N. Spon, Ltd., 57, Haymarket, London, S.W.* 1916. *6s. net.* 488 *pp.*, 325 *illustrations.*)

THIS little booklet contains a great deal of useful condensed information. There is a liberal allowance of illustrations, and an adequate index.

The early part of the book is devoted to the usual mathematical and conversion tables, logarithms, &c., after which we have particulars of electric mains, and sections on Insulation and Resistance, Continuous and Alternating Machinery, Electrochemistry, Traction, &c. One interesting feature is the reproduction of the Italian graphic symbols, with appropriate Italian, English and French wording applied to represent various instruments, appliances and conditions in electrical technology.

In the section on lighting the matter is brought up to date by the inclusion of data on the gas-filled lamps, and even the recently introduced arc-incandescent lamp. Some figures for the illumination of various classes of premises and the lighting of streets and railways are also given. The data on railways, however, appear to be taken from information published in 1906 and might, perhaps, be supplemented by particulars from more recent papers before the Illuminating Engineering Society. Similarly, in regard to streets, the classification in the Draft Standard Specification for Street Lighting might be included. Some fuller reference to industrial lighting and the Report of the Home Office Departmental Committee would also be welcome. Finally it may be suggested that the design of reflectors, and their division into extensive, intensive, and focussing types might, in a future edition, be explained.

The section of tramways and electric railways appears to be fully dealt with, and the work is concluded by a reproduction of the I.E.E. wiring rules.

PUBLICATIONS RECEIVED.

The Transactions of the Illuminating Engineering Society (*U.S.A.*) for October contain papers on the following:—"Lighting in the Army," "The Selection of a Standard Unit in Commercial Lighting," "The Artificial Illumination of Interiors as related to Architecture and Decoration: Gas Lighting in a Cathedral."

The Journal of the Franklin Institute (October) contains an interesting address by Mr. Walton Clark entitled "A Century of Light," tracing the development of illumination in the United States since 1815.

Among recent bulletins of the *Bureau of Standards* may be noted:—No. 60 on "Electric Units and Standards," in which the evolution of the various units is explained and the practice of various countries summarised; No. 292 on "International System of Electric and Magnetic Units," a suggestive contribution by J. H. Dellinger, forming a useful supplement to the above; and No. 277 on "An Interlaboratory Photometric Comparison of Glass Screens and Tungsten Lamps involving Colour Differences."

The Proceedings of the American Philosophical Society (Vol. LV., No. 6, 1916) contains a contribution by Dr. E. D. Nichols on the "Phosphorescence of certain Metallic Sulphides."

Colour (October, 1916) contains a series of striking coloured reproductions of landscapes and studies of various kinds. The "Portrait of an Eastern Dancer" is not without interest as an example of spectacular lighting effects.

FATIGUE, AND ITS EFFECTS ON INDUSTRY AND EFFICIENCY.

(*Chadwick Public Lectures, delivered on October 27th, November 3rd, and November 10th, by Professor E. Stirling, M.D., D.Sc., LL.D.*)

These lectures, which were delivered before a numerous and appreciative audience at the Royal Society of Arts, were devoted respectively to (1) The Physiological Basis of Fatigue; (2) Some Industrial Aspects of Fatigue; and (3) Fatigue—a Universal Phenomenon of Life.

It was shown how even the simplest operations cause faitgue of the muscles, the brain, or the senses, how recuperation takes place, and how, if the strain is too severe or prolonged, the recovery is proportionately slow. One of the many ingenious devices for measuring fatigue is the ergograph, by means of which the power of raising a weight by the fingers is graphically recorded. Professor Stirling showed a great number of diagrams obtained in this way, many of which illustrated the effect of excessive fatigue in diminishing the available muscular effort and retarding the recovery to a normal state. Others showed the long-continued effects of a muscular strain, and the lowered vitality resulting from semi-starvation and insufficient sleep.

All of this has a direct bearing of factory operations, and the lecturer was able to show, by such diagrams, how important it is to allot periods for recuperation on a scientific plan, in order to get the maximum output. Some instructive diagrams were presented, based on data obtained both in British and French factories, showing how with increasing hours of work, the output becomes stationary and even falls off; how accidents tend to rise steadily after the interval for refreshment, and tend to a maximum about 5 p.m., shortly before the working day terminates. Equally interesting was a diagram indicating how the output of workers is prejudicially affected by over-indulgence in alcohol.

The lecture was illustrated by cinematograph films, showing operations in munition factories, and the conditions in and behind the trenches at the Front.

HEALTH AND HYGIENE.

A leaflet under the above title, issued by the Incorporated Institute of Hygiene, contains a variety of interesting notes, written in a condensed but popular manner, relating to health.

It is stated that in Germany a serious form of blood-poisoning, due to continual feeding on preserved foods ("tin-sickness"), has been making its appearance; that soft caoutchouc artificial eyes are now being substituted for glass on account of their greater convenience and flexibility; that recent Zeppelin raids have annoyed the cows, and prejudicially affected the supply of milk; that while many rich people are economising by buying margarine instead of butter, many workers, who are receiving higher wages than before, are doing the exact reverse.

INDEX, November, 1916.

HEALTH OF MUNITION WORKERS' COMMITTEE.

Two additional bulletins have been recently issued by this Committee. Memorandum No. 11 contains a Report by Dr. Leonard Hill on "An Investigation of Workers' Food and Suggestions as to Dietary"; Memorandum No. 14 deals with "Washing Facilities and Baths."

Dr. Leonard Hill discusses the conditions determining the wastage that requires to be made good by daily consumption of food, and analyses the constituents of common meals into protein, fat and carbohydrate. Specimens of daily dietaries from hostels and canteens are reproduced. Finally a suggested daily dietary for munition workers, together with the cost of each meal, is presented.

One receives the impression that if meals of this kind were universal there would be little to complain of on the score of dietary. In works where well-stocked canteens are provided the care and expense involved must be amply repaid by the better health and work of employees.

Memorandum No. 14 contains some very practical suggestions on bathing and washing facilities—a matter which in the past has undoubtedly been badly neglected in many large factories. We notice that the shower or douche bath is strongly recommended, a view which, we believe, is in accordance with the best Continental experience.

THE BRITISH COMMERCIAL GAS ASSOCIATION.

The Fifth Annual Meeting of the British Commercial Gas Association took place in the Hall of the Royal Society of Arts on November 1st, the chair being taken by the President (Sir Hallewell Rogers). Mr. F. W. Goodenough (Chairman of the Executive Committee) presented the Annual Report for the past year, from which it appears that the Association is maintaining its full activities in spite of the inevitable difficulties of war-time. During the past two years of war it has added about seventy new undertakings to the list of those giving support, which now number nearly 500.

This is a record which must be very gratifying to the supporters of the Association, and particularly to its enterprising and energetic Chairman, Mr. Goodenough. We notice, too, the President's reference to the action taken in Birmingham, where there is now a laboratory with a staff of chemists to whom general problems relating to gas supply and manufacture may be referred.

Of special interest is the recent formation of a National Gas Council, which is intended to be a body representative of the entire gas industry, and which, no doubt, will, among other things, devote itself to the encouragement of research. When one considers the vast ramifications of the gas industry in this country one cannot but be struck by the opportunities for concerted effort. The formation of the British Commercial Gas Association has been fully justified by the experience of the last few years, and no doubt by the time the war is over there will be many other instances of co-operation to record.

The Illuminating Engineering Society.

(FOUNDED IN LONDON, 1909.)

NOTICE OF ANNUAL MEETING.

A Meeting of the Society will take place at the House of the Royal Society of Arts (18, John Street, Adelphi, London), at **5 p.m.,** on Tuesday, January 16th, 1917, when a Discussion on ***"The Lumen" as a Measure of Illuminating Power*** will be opened by Professor J. T. MORRIS.